

What is claimed is:

1. A demodulator for demodulating an in-phase component modulated signal with an in-phase component carrier wave signal to produce an in-phase component signal and demodulating a  
5 quadrature component modulated signal with a quadrature component carrier wave signal to produce a quadrature component signal, the demodulator comprising:

fixed frequency signal generating means for generating two signals of fixed frequency differing 90 degrees in phase;

10 variable frequency signal generating means for generating a signal whose frequency can be varied according to a modulated signal;

in-phase component carrier wave signal generating means for mixing one signal generated by the fixed frequency signal generating means and the signal generated by the variable frequency signal generating means to generate a carrier wave signal for an in-phase component;

15 quadrature component carrier wave signal generating means for mixing the other signal generated by the fixed frequency signal generating means and the signal generated by the variable frequency signal generating means to generate a carrier wave signal for a quadrature component;

in-phase component demodulating means for demodulating an in-phase component modulated signal with the in-phase component carrier wave signal generated by the in-phase component carrier wave signal generating means to produce an in-phase component signal; and

20 quadrature component demodulating means for demodulating a quadrature component modulated signal with the quadrature component carrier wave signal generated by the quadrature component carrier wave signal generating means to produce a quadrature component signal.

2. A demodulator according to claim 1, wherein:

25 the fixed frequency signal generating means is constituted using a local signal oscillator that generates a fixed frequency and a 90-degree phase shifter that shifts the phase of the signal generated by the local signal oscillator 90 degrees.

3. A demodulator according to claim 2, wherein:

the variable frequency signal generating means is constituted by a voltage-controlled oscillator, the in-phase component carrier wave signal generating means is constituted by an in-phase component side first mixer and filter, the quadrature component carrier wave signal generating means is constituted by a quadrature component side first mixer and filter, the in-phase component demodulating means is constituted by an in-phase component side second mixer, and the quadrature component demodulating means is constituted by a quadrature component side second mixer;

the local signal oscillator generates a signal whose frequency constitutes a basic carrier wave frequency and outputs the signal to the 90-degree phase shifter and the in-phase component side first mixer;

the 90-degree phase shifter shifts the phase of the signal received from the local signal oscillator 90 degrees and outputs the phase-shifted signal to the quadrature component side first mixer;

the voltage-controlled oscillator generates a signal having a frequency corresponding to a voltage applied thereto and outputs the signal to the in-phase component side first mixer and the quadrature component side first mixer;

the in-phase component side first mixer mixes the signal received from the local signal oscillator and the signal received from the voltage-controlled oscillator and outputs the mixing result to the in-phase component side filter;

the in-phase component side filter removes unnecessary frequency components from the mixing result received from the in-phase component side first mixer by filtering and outputs the filtered signal to the in-phase component side second mixer as an in-phase component carrier wave signal;

the in-phase component side second mixer mixes the in-phase component carrier wave signal received from the in-phase component side filter and the composite signal to demodulate the composite signal with the in-phase component carrier wave signal and outputs the in-phase component signal produced by the demodulation;

the quadrature component side first mixer mixes the signal received from the 90-degree phase shifter and the signal received from the voltage-controlled oscillator and outputs the mixing result to

the quadrature component side filter;

the quadrature component side filter removes unnecessary frequency components from the mixing result received from the quadrature component side first mixer by filtering and outputs the filtered signal to the quadrature component side second mixer as a quadrature component carrier wave signal; and

the quadrature component side second mixer mixes the quadrature component carrier wave signal received from the quadrature component side filter and the composite signal to demodulate the composite signal with the quadrature component carrier wave signal and outputs the quadrature component signal produced by the demodulation.

4. A demodulator according to claim 1, wherein:

the fixed frequency signal generating means is constituted by a digital unit, the variable frequency signal generating means is constituted by a voltage-controlled oscillator, the in-phase component carrier wave signal generating means is constituted by an in-phase component side first mixer and filter, the quadrature component carrier wave signal generating means is constituted by a quadrature component side first mixer and filter, the in-phase component demodulating means is constituted by an in-phase component side second mixer, and the quadrature component demodulating means is constituted by a quadrature component side second mixer;

the digital unit generates a basic carrier wave frequency signal and outputs the signal to the in-phase component side first mixer and generates a signal equivalent to a signal obtained by shifting the phase of the basic carrier wave frequency signal 90 degrees and outputs the signal to the quadrature component side first mixer;

the voltage-controlled oscillator generates a signal having a frequency corresponding to a voltage applied thereto and outputs the signal to the in-phase component side first mixer and the quadrature component side first mixer;

the in-phase component side first mixer mixes the signal received from the digital unit and the signal received from the voltage-controlled oscillator and outputs the mixing result to the in-phase component side filter;

the in-phase component side filter removes unnecessary frequency components from the

mixing result received from the in-phase component side first mixer by filtering and outputs the filtered signal to the in-phase component side second mixer as an in-phase component carrier wave signal;

5 the in-phase component side second mixer mixes the in-phase component carrier wave signal received from the in-phase component side filter and the composite signal to demodulate the composite signal with the in-phase component carrier wave signal and outputs the in-phase component signal produced by the demodulation;

10 the quadrature component side first mixer mixes the signal received from the digital unit and the signal received from the voltage-controlled oscillator and outputs the mixing result to the quadrature component side filter;

the quadrature component side filter removes unnecessary frequency components from the mixing result received from the quadrature component side first mixer by filtering and outputs the filtered signal to the quadrature component side second mixer as a quadrature component carrier wave signal; and

15 the quadrature component side second mixer mixes the quadrature component carrier wave signal received from the quadrature component side filter and the composite signal to demodulate the composite signal with the quadrature component carrier wave signal and outputs the quadrature component signal produced by the demodulation.

20 5. A communication device equipped with a demodulator for demodulating an in-phase component modulated signal with an in-phase component carrier wave signal to produce an in-phase component signal and demodulating a quadrature component modulated signal with a quadrature component carrier wave signal to produce a quadrature component signal and adapted to conduct communication using carrier waves of multiple frequencies and demodulate received modulated  
25 signals with the demodulator,

the demodulator of the communication device comprising fixed frequency signal generating means for generating two signals of fixed frequency differing 90 degrees in phase; variable frequency signal generating means for generating a signal whose frequency can be varied according to a modulated signal; in-phase component carrier wave signal generating means for mixing one signal

generated by the fixed frequency signal generating means and the signal generated by the variable frequency signal generating means to generate a carrier wave signal for an in-phase component; quadrature component carrier wave signal generating means for mixing the other signal generated by the fixed frequency signal generating means and the signal generated by the variable frequency signal generating means to generate a carrier wave signal for a quadrature component; in-phase component demodulating means for demodulating an in-phase component modulated signal with the in-phase component carrier wave signal generated by the in-phase component carrier wave signal generating means to produce an in-phase component signal; and quadrature component demodulating means for demodulating a quadrature component modulated signal with the quadrature component carrier wave signal generated by the quadrature component carrier wave signal generating means to produce a quadrature component signal.

6. A communication device according to claim 5, wherein:

the fixed frequency signal generating means is constituted using a local signal oscillator that generates a fixed frequency and a 90-degree phase shifter that shifts the phase of the signal generated by the local signal oscillator 90 degrees.

7. A communication device according to claim 6, wherein:

the variable frequency signal generating means is constituted by a voltage-controlled oscillator, the in-phase component carrier wave signal generating means is constituted by an in-phase component side first mixer and filter, the quadrature component carrier wave signal generating means is constituted by a quadrature component side first mixer and filter, the in-phase component demodulating means is constituted by an in-phase component side second mixer, and the quadrature component demodulating means is constituted by a quadrature component side second mixer;

the local signal oscillator generates a signal whose frequency constitutes a basic carrier wave frequency and outputs the signal to the 90-degree phase shifter and the in-phase component side first mixer;

the 90-degree phase shifter shifts the phase of the signal received from the local signal oscillator 90 degrees and outputs the phase-shifted signal to the quadrature component side first

mixer;

the voltage-controlled oscillator generates a signal having a frequency corresponding to a voltage applied thereto and outputs the signal to the in-phase component side first mixer and the quadrature component side first mixer;

5        the in-phase component side first mixer mixes the signal received from the local signal oscillator and the signal received from the voltage-controlled oscillator and outputs the mixing result to the in-phase component side filter;

10       the in-phase component side filter removes unnecessary frequency components from the mixing result received from the in-phase component side first mixer by filtering and outputs the filtered signal to the in-phase component side second mixer as an in-phase component carrier wave signal;

15       the in-phase component side second mixer mixes the in-phase component carrier wave signal received from the in-phase component side filter and the composite signal to demodulate the composite signal with the in-phase component carrier wave signal and outputs the in-phase component signal produced by the demodulation;

the quadrature component side first mixer mixes the signal received from the 90-degree phase shifter and the signal received from the voltage-controlled oscillator and outputs the mixing result to the quadrature component side filter;

20       the quadrature component side filter removes unnecessary frequency components from the mixing result received from the quadrature component side first mixer by filtering and outputs the filtered signal to the quadrature component side second mixer as a quadrature component carrier wave signal; and

25       the quadrature component side second mixer mixes the quadrature component carrier wave signal received from the quadrature component side filter and the composite signal to demodulate the composite signal with the quadrature component carrier wave signal and outputs the quadrature component signal produced by the demodulation.

8. A communication device according to claim 5, wherein:

the fixed frequency signal generating means is constituted by a digital unit, the variable frequency signal generating means is constituted by a voltage-controlled oscillator, the in-phase component carrier wave signal generating means is constituted by an in-phase component side first mixer and filter, the quadrature component carrier wave signal generating means is constituted by a quadrature component side first mixer and filter, the in-phase component demodulating means is constituted by an in-phase component side second mixer, and the quadrature component demodulating means is constituted by a quadrature component side second mixer;

the digital unit generates a basic carrier wave frequency signal and outputs the signal to the in-phase component side first mixer and generates a signal equivalent to a signal obtained by shifting the phase of the basic carrier wave frequency signal 90 degrees and outputs the signal to the quadrature component side first mixer;

the voltage-controlled oscillator generates a signal having a frequency corresponding to a voltage applied thereto and outputs the signal to the in-phase component side first mixer and the quadrature component side first mixer;

the in-phase component side first mixer mixes the signal received from the digital unit and the signal received from the voltage-controlled oscillator and outputs the mixing result to the in-phase component side filter;

the in-phase component side filter removes unnecessary frequency components from the mixing result received from the in-phase component side first mixer by filtering and outputs the filtered signal to the in-phase component side second mixer as an in-phase component carrier wave signal;

the in-phase component side second mixer mixes the in-phase component carrier wave signal received from the in-phase component side filter and the composite signal to demodulate the composite signal with the in-phase component carrier wave signal and outputs the in-phase component signal produced by the demodulation;

the quadrature component side first mixer mixes the signal received from the digital unit and the signal received from the voltage-controlled oscillator and outputs the mixing result to the quadrature component side filter;

the quadrature component side filter removes unnecessary frequency components from the mixing result received from the quadrature component side first mixer by filtering and outputs the filtered signal to the quadrature component side second mixer as a quadrature component carrier wave signal; and

- 5       the quadrature component side second mixer mixes the quadrature component carrier wave signal received from the quadrature component side filter and the composite signal to demodulate the composite signal with the quadrature component carrier wave signal and outputs the quadrature component signal produced by the demodulation.